A Process Model for Deployment Planning of Ground-based Air Defense System Against Asymmetric Homeland Threat

Ronald L. Cypert
Scientific Research Corporation
(719) 554-0543
ronald.cypert@smdc-cs.army.mil

ABSTRACT: The Joint Air Defense Operations – Homeland (JADO-H) Joint Test (JT) was chartered on August 15, 2007, in support of North American Air Defense Command (NORAD) / U.S. Northern Command (NORTHCOM) mission to protect the homeland against asymmetric air and cruise missile attacks. The JADO-H test team was given the specific focus of developing planning tactics, techniques, and procedures supporting the Deployable – Homeland Air and Cruise Missile Defense (D-HACMD) concept of operations (CONOPS) completed by NORAD in 2005.

Since completion of the CONOPS, an actual deployment of this ground-based Army missile point-defense system in the homeland has occurred only twice….on both occasions there were several months of planning lead time required for successful coordination.

As can be imagined the ability to deploy this system in a crisis situation is critical. Because planning for this mission area encompasses so many Department of Defense organizations and echelons of command, i.e. NORAD/NORTHCOM, U.S. Army North (ARNORTH), U.S. Air Force North (AFNORTH), CONUS NORAD Region (CONR), National Guard Bureau, U.S. Joint Forces Command (JFCOM), Air Combat Command (ACC), Forces Command (FORSCOM), Army air defense units, Air Force communication units, along with coordination at the state and federal agency level, a dynamic process modeling capability was chosen to chart the myriad interactions among these disparate organizations.

Using SIMPROCESS software the JADO-H JT team is currently populating the model through process interviews with numerous "subject matter experts" at the various organizations involved. The technicalities of accurately modeling a crisis action process that, to-date, does not really exist are daunting. The JADO-H JT team hopes to use the model to evaluate possible duplicative sub-processes, bottlenecks in the process flow or "long poles in the tent", and to create a clearly-defined repeatable process that can be "trained to" by the warfighters. The software will also easily allow alternate sub-process simulation enabling recommended process efficiencies.

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1. History – Why a Deployable Ground-based Air Defense (GBAD) Against a Homeland Air Threat?

The idea of homeland GBAD is not a new or novel concept. In March 1951 the U.S. Army Antiaircraft Command (later re-designated Army Air Defense Command (ARADCOM)) became responsible for all antiaircraft forces assigned to air defense of the United States under the command of NORAD. From the mid-fifties to 1979 Army Nike Hercules and Hawk missile batteries were a major contributor to the protection of North American air space.

September 11, 2001, galvanized our nation as we witnessed that our enemies have the resolve and means to commit acts of terrorism against innocent civilians and commercial interests within our borders. Immediate action sent scores of fighter aircraft into the skies to protect our sovereign air space from further attack. Without the ground-based air defenses of previous decades, this was the only defense at the time. It was quickly realized that a 24/7 Combat Air Patrol (CAP) status was impossible to maintain indefinitely. Many changes in national defense rhetoric have emanated from this singular event.

In 2005 the National Defense Strategy stated: "Secure the United States from direct attack. We will give top priority to dissuading, deterring, and defeating those who seek to harm the United States directly, especially extremist enemies with weapons of mass destruction."

Specifically the 2006 Homeland Aviation Security Policy (NSPD-47 & HSPD-16) directed a national effort to: "…protect the U.S.…from terrorist attacks…or unlawful exploitation…in the Air Domain.…must address current and future aviation threats, including…low observable aerial vehicles…"

Actual deployment of the current D-HACMD-like system has taken place three times since 9/11. NORAD established a ground-based Integrated Air Defense System (IADS) initially deployed in the National Capitol Region (NCR) in February of 2003. These air defense sites remain on 24/7 alert status even today. A second deployment took place to protect the skies over the Group of Eight (G8) Summit at Sea Island, GA, in 2004. This successful deployment was preceded by an 8-month planning period. Most recently, following Concept of Operations (CONOPS) approval in 2006, Commander, North American Air Defense Command (NORAD) directed a proof-of-concept demonstration at Point Magu, CA. The conclusion following this live system deployment was that tactics, techniques, and procedures needed to be improved to allow the Joint Warfighter to rapidly integrate into the D-HACMD IADS architecture.

2. Introduction – Why a Joint Test?

The OSD Joint Test & Evaluation (JT&E) program was created by the 1972 Presidential Commission and placed under Title 10 U.S.C Section 133. The OSD JT&E program is currently guided by DoD Instruction 5010.41 to:

- Provide quantitative information used for analyses of joint military capabilities and potential options for increasing interoperability
- Conduct tests and evaluations to provide information required by Congress, OSD, Combatant Commands (COCOMs), and DoD components involved in joint operations

JT&Es have proven an effective venue for developing tactics, processes, and procedures, based on rigorous test analysis, where immature or non-codified processes existed prior to the test.

In a broad sense, the purposes of the JT&E program are to bring two or more Military Departments or Components together to:

- Test non-materiel approaches designed to improve mission performance with today's equipment, organization, and doctrine
- Evaluate joint technical and operational concepts and recommend improvements
- Increase joint mission capability using quantitative data for analysis
- Improve joint tactics, techniques, and procedures (JTTP)
- Improve joint training
- Provide feedback and transition tested products to the joint warfighter community

To date over 65 JT&Es have been chartered under the auspices of this program with participation from all the military services, the U.S. Coast Guard, and numerous other federal agencies. Under the current OSD JT&E program, joint test issues can be addressed with a 3-year JT&E or a 1-year Quick Reaction Test (QRT). Figure 1 depicts the OSD selection process for these two types of formal testing venues.

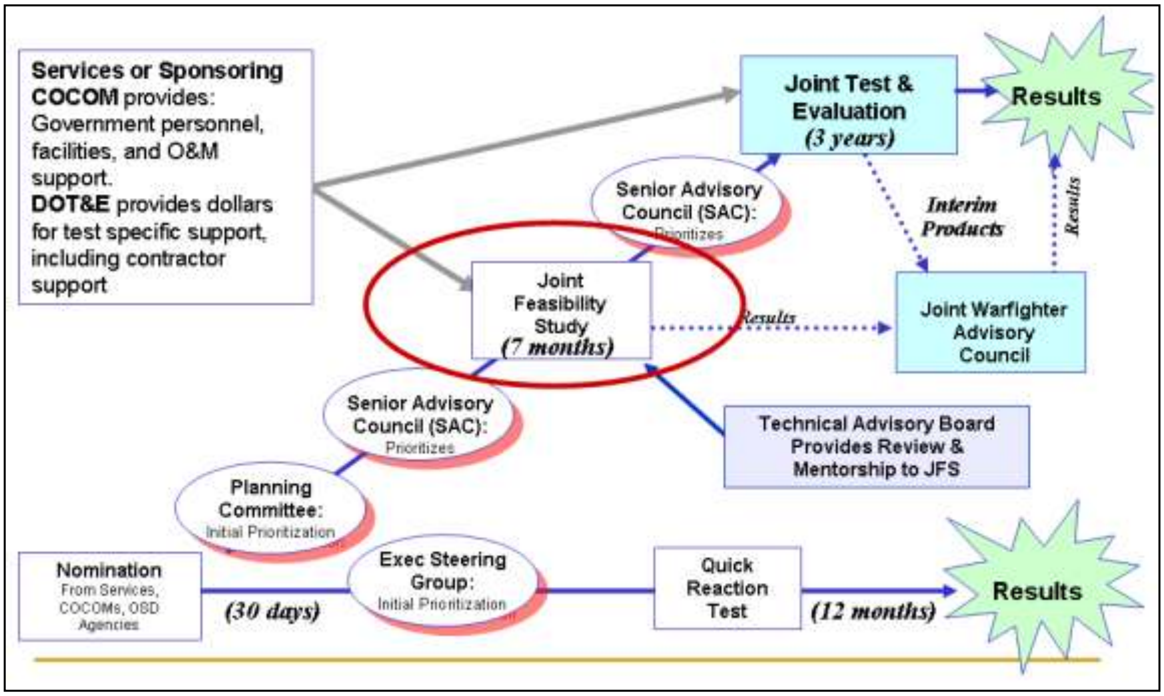

Figure 1 Joint Test and Evaluation Selection Process

The Joint Air Defense Operations – Homeland (JADO-H) JT&E received OSD charter on August 15, 2007. Over a three year period, with a staff of 10 uniformed personnel and 22 contractors, led by an Army colonel, the JADO-H JT&E will develop, test, and evaluate D-HACMD joint planning tactics, techniques, and procedures to enhance homeland defense against an asymmetric air threat. North American Aerospace Defense (NORAD) Command and the United States Northern Command (USNORTHCOM) are the operational sponsors for the JADO-H JT&E.

3. What Organizations Are Typically Involved with a Homeland Asymmetric Air Threat?

During the three year effort the Joint Test team will work intimately with the following defense and federal organizations:

<u>Warfighter Organizations</u>
NORAD, NORTHCOM, ARNORTH, AFNORTH, CONR, Commander Pacific Fleet (CINCPACFLT), Army air defense units, Air Force communications units

<u>Force Provider Organizations</u>
JFCOM, ACC, FORSCOM, Fleet Forces Command (FFC), National Guard Bureau

<u>Federal Agencies</u>
Federal Aviation Administration (FAA), Secret Service, Transportation Security Administration (TSA) and many others

4. How will the Joint Test Document D-HACMD Deficiencies and Measure Progress at Completion?

During a 7-month period called the "Joint Feasibility Study (JFS)", just prior to Joint Test charter, the test team worked closely with the organizations involved in the process being studied and the operational sponsors to develop the overall Joint Test "Problem Statement":

> *"Current D-HACMD planning TTP is not sufficiently formalized to enable combined force effectiveness to support defeating asymmetric aerial threats directed against a designated defended asset."*

National or theater level exercises are often used as venues to support the testing of formal "Test Issues" associated with the Joint Test Problem Statement. The JADO-H JFS decided on two such test issues to facilitate measurement of a D-HACMD scenario within a national level exercise:

> *"To what extent does formalized D-HACMD planning TTP enable effective development of the combined forces D-HACMD plan to support defeating asymmetric aerial threats directed against a designated defended asset?"*

Secondly, because the deployment of a homeland integrated air defense (IAD) system will most likely always be at the request of a lead federal agency,

> *"To what extent does formalized D-HACMD planning TTP enable effective development of the plan to use interagency air and cruise missile defense capabilities to support defeating asymmetric aerial threats directed against a designated defended asset?"*

In order to make quantifiable observations during the exercise, these test issues are further broken down into Measures of Effectiveness (MOEs) and Measures of Performance (MOPs).

Through interviews and observations during national level exercises (NLE), test team subject matter experts (SME) are developing numerous operational level TTPs to support the D-HACMD functions at the various organizations involved. Using the "develop-test-develop" method during three NLEs, it is expected that these TTPs will make a significant contribution to formalizing crisis action IAD processes and procedures employed against a homeland aerial threat.

5. Why Does the Joint Test & Evaluation Include a D-HACMD Dynamic Process Model?

As is often the case with issues under test in the JT&E program, the crisis action planning process for D-HACMD that is being studied is embryonic in a doctrinal sense. Although

a preponderance of warfighter SMEs state their confidence in current procedures to handle an aerial threat, roles and responsibilities for operational level tasks necessary for the deployment of an IAD system have not been codified and indeed because there is no joint TTP, even during exercises there has been confusion with command and control of planning procedures. At the conclusion of this Joint Test the process model will depict the "big picture" of the overall planning roles and responsibilities for D-HACMD deployment agreed upon among the various organizations involved.

The role of the test team modeler is to constantly be looking for identifiable sub-processes, and thinking about how to properly depict the details in the model. Since defined roles and responsibilities for D-HACMD are seriously lacking, it was decided to identify and include in the model (as place holders so to speak) where processes "DO NOT" currently exist. Normally these instances are referred to as "gaps" in the overall process, but in this case it might be more applicable to describe them as "non-process" points worthy of actually highlighting in the model.

Since construction of the model is a joint venture between the modeler, the test team SMEs, and the actual warfighter SMEs, the exercise of process discovery can prove to be an educational experience for all involved. Model creation (data collection) is also many times a "forcing function" for process solidification, i.e. to complete the model, identified sub-tasks need to be sequenced and connected. This modeling procedure causes the SMEs and warfighters to think through and come to agreement on the D-HACMD planning process steps.

Currently model construction consists of a static depiction of the various internal sub-processes that exist at the numerous organizations involved. Our TTP will be executed by exercise participants at two formal field tests and also at a Table Top exercise (TTX) (see section 6 for explanation of this fact-finding event). Process observations at these three events will be used to complete the model by joint test's end.

Quite often a JT process model turns out to be an extremely useful training and awareness tool. As the codified procedures are exercised and trained to in the future, the dynamic simulation capabilities of the model may also be able to lead to efficiencies in the timeliness of system deployment.

6. Limiting Assumptions for the Model and Data Capture Techniques

Model validation is defined as, "the process of determining whether a simulation model (as opposed to the computer program) is an accurate representation of the system, *for the particular objectives of the study*." (Law & Kelton, 2000)

Modeling the D-HACMD deployment planning process presents a unique validation challenge in two ways:

- The complexities in the overall process are so extensive that the same planning scenario may never include the same "mix" twice. These complexities include:
    - Organizations involved (Federal, State, Municipal, Tribal), especially what organization is actually the lead agency at the deployment site
    - How civilian agencies involved interface with a DoD presence at the site
    - Whether DoD real property is available at the site for missile and sensor units to set up equipment
    - Issues concerning whether mobilized troops are Title 10 (active duty) or Title 32 (National Guard)
    - State variations in selection and mobilization procedures of National Guard troops and equipment
    - Method for funding troop and equipment movement
- An exercised, and agreed upon, overall D-HACMD deployment planning process does not presently exist

The finished model will attempt to convey the inter-relationships and dependencies of these complexities in a clear and concise manner.

Having been the chief modeler on three OSD JT&Es to date, there seems to be one inherent limitation that holds true: there is a dichotomy of knowledge and understanding that you must bridge as the modeler. You understand the capabilities and limitations of the modeling tool and the data needed to populate it, but not the system being studied. Project SMEs understand the system, but not the characteristics of the model. This fact is included here because it tends to be an inherent "assumption" of the finished model. That is, that you as the modeler have found the right people to extract the right kinds of process knowledge from, whether they are test team SMEs or warfighters. And then you have to connect this discovered knowledge in the model correctly so that it is valid. Others can be enlisted to aid in validating the completed model, but you are ultimately alone in fully understanding your modeling conventions.

This process knowledge (data gathering) is usually captured in interviews with the involved SMEs or observed during exercise participation. It has usually been found that SMEs are able to identify sub-tasks/activities their organization performs without too much difficulty, but it is the inter-organizational relationships and data dependencies stemming from these relationships that are most often not documented or understood as well. The Data Capture Worksheet (Figure 2) is a tremendous aid to the modeler in forcing the SME to "think harder" concerning the details surrounding the sub-task/activity he performs or oversees.

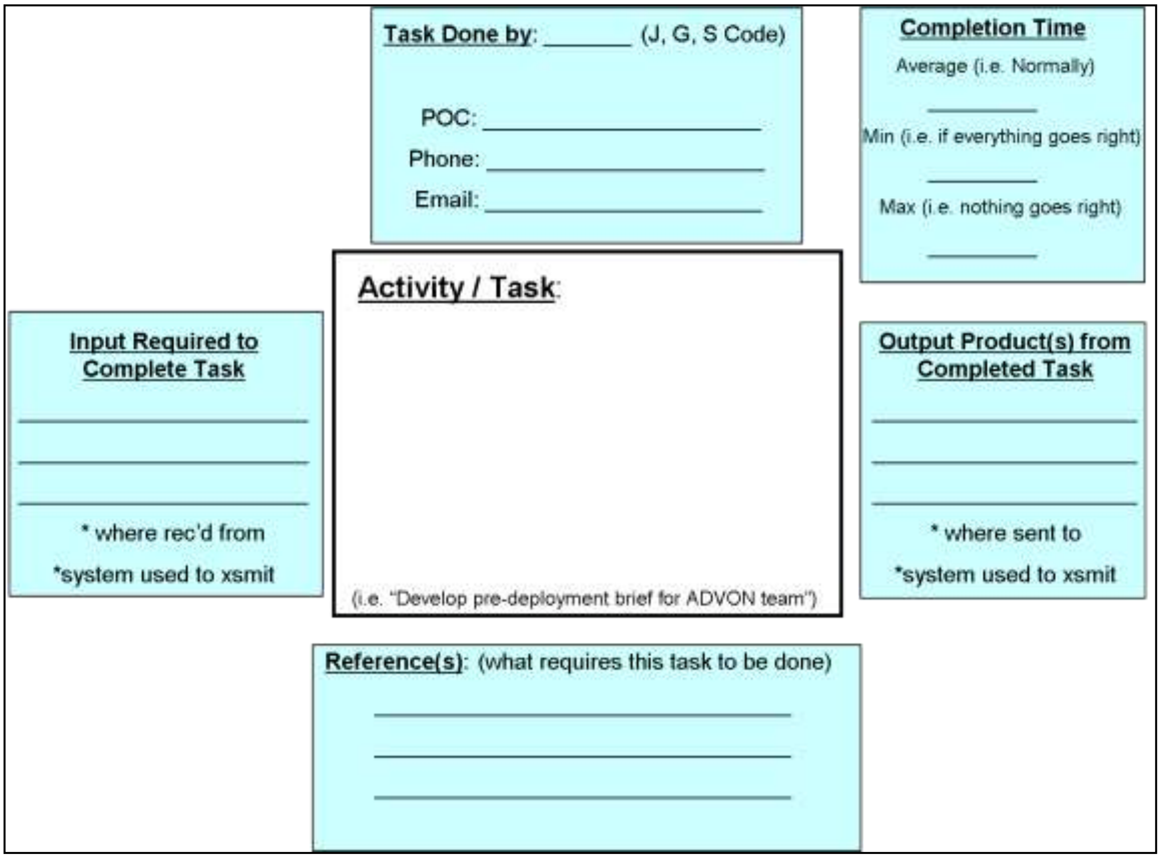

Figure 2 Process Capture Interview Sheet

The details included in the worksheet are essential to building a definitive dynamic model. It is a common experience following a process discovery interview that the warfighter SME expresses an amazed appreciation for what you have just experienced together. In some instances you jointly discover, "You didn't know what you didn't know." I re-emphasize that this "process capturing effort" is very much a "forcing function" to stimulate warfighter SMEs to think beyond simply enunciating a sub-task description, and begin to define all the "extras" associated with the sub-task, i.e. inputs required *from whom*, output products *sent to who*, timing sequence and inter-dependencies, qualifications needed to properly perform the task, and systems necessary to convey the inputs/outputs. These details can be easily overlooked in a project of this magnitude, but at project's end "the devil is still in the details."

A unique data capture opportunity to JADO-H is a Table Top exercise (TTX). We are now preparing for our second TTX. Over a multiple day period, battle staffs of the organizations involved are sequestered in separate armory classrooms. Internet, virtual tele-conferences (VTC) and voice communications connect the classrooms as if the participating units were hundreds of miles distant. An exercise white cell disseminates a D-HACMD scenario to stimulate the exercise. This situation is unique in several ways:

- All organization cells are easily observable since they are just down the hall from each other

- Our test team, which develops the overall scenario and Master Scenario Event List (MSEL), mans the "white cell" giving us total control over the exercise injects
- The exercise can be "stopped" or "slowed down" if need be for clarity of intent or group discussion as appropriate
- The D-HACMD scenario is the focus of the exercise as opposed to competing with other exercise objectives or scenarios

Our first TTX was a "process-rich environment" both during exercise play and afterward as post-event analysis. We expect our second TTX to also provide great process insight.

7. Current Model Detail

Figure 3 is only a small section of the overall D-HACMD model. It is typical of a process model in that tasks, product flows and dependencies, event sequence, and hierarchy of organizations are depicted. The dynamic capability of the modeling tool described in Section 8 below enables the timing sequence to be incorporated with the static architecture seen here.

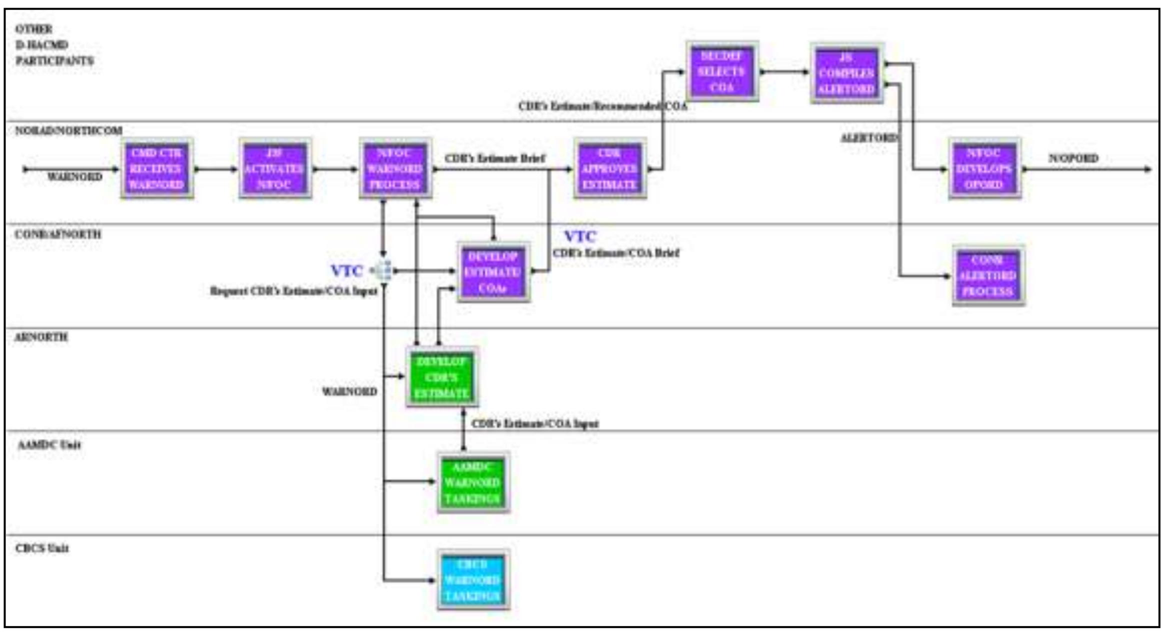

Figure 3 Excerpt D-HACMD SIMPROCESS Model

8. The SIMPROCESS Dynamic Modeling Tool

The goal of any process modeling effort is to create a simplified but useful analysis tool for evaluating a business enterprise. Some common reasons for this analysis are to:

- Identify bottlenecks or wasted effort

- Recommend beneficial revisions to the process to correct performance problems
- Select process designs that give the best results
- Identify duplication

Although some *static modeling tools* can prove useful for these types of analysis, the dynamic simulation capabilities of SIMPROCESS uniquely provide for the following:

- Time-varying nature of many processes
- Non-linear interactions among elements of a process
- Random behavior of most real processes
- Unexpected events in the business environment

The bottom line is that most processes are not well characterized by deterministic, mathematical models, and many modeling tools today do not allow a quantified analysis of the process under study. A computerized dynamic model simulates the flow of materials and information through the process accounting for the random variations in how work is done in the real world. Simulation offers several advantages over a simple pictorial abstraction of a business process:

- First, the analyst can correlate the data produced by the model with measurements taken from the real processes to increase certainty that the model has adequately captured the essential features of the real process.
- Second, the model will generate quantified process measurements such as: excess capacity or bottlenecks, the time it takes work items to flow through the process, and the percentage of time expended in value-adding processes versus non-value-adding processes.
- Third, the model allows the analyst to evaluate, in quantified terms, the effects of reengineering the process.

SIMPROCESS, as a single tool, integrates a process mapping capability with hierarchical event-driven simulation and activity-based costing (ABC).

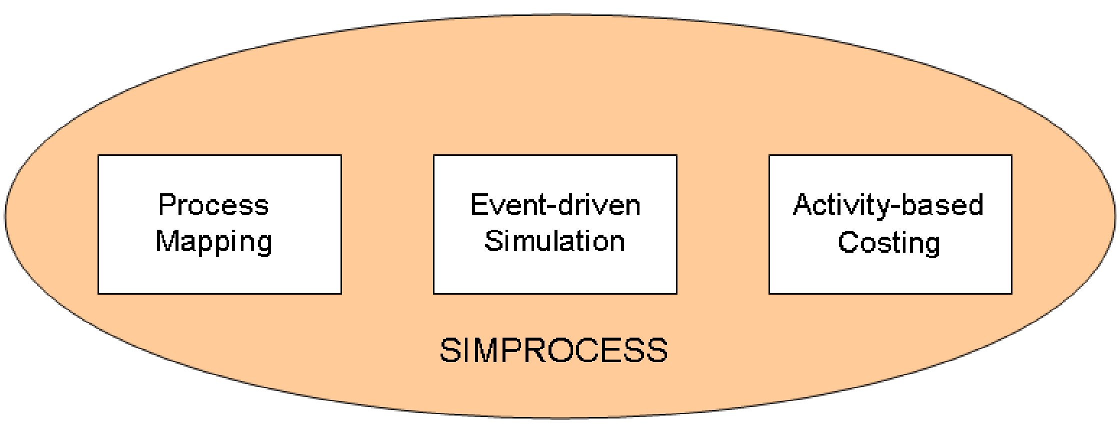

Figure 4 SIMPROCESS Capability Integration

The architecture of SIMPROCESS provides an integrating framework for ABC which embodies the concept that the functions of an organization are a series of inter-related processes, and that these processes consist of activities that convert inputs to outputs. Post simulation analysis enables a test team to determine where sub-processes can be modified for improved efficiency, evaluate alternatives in management policies, and determine cost savings associated with these modifications.

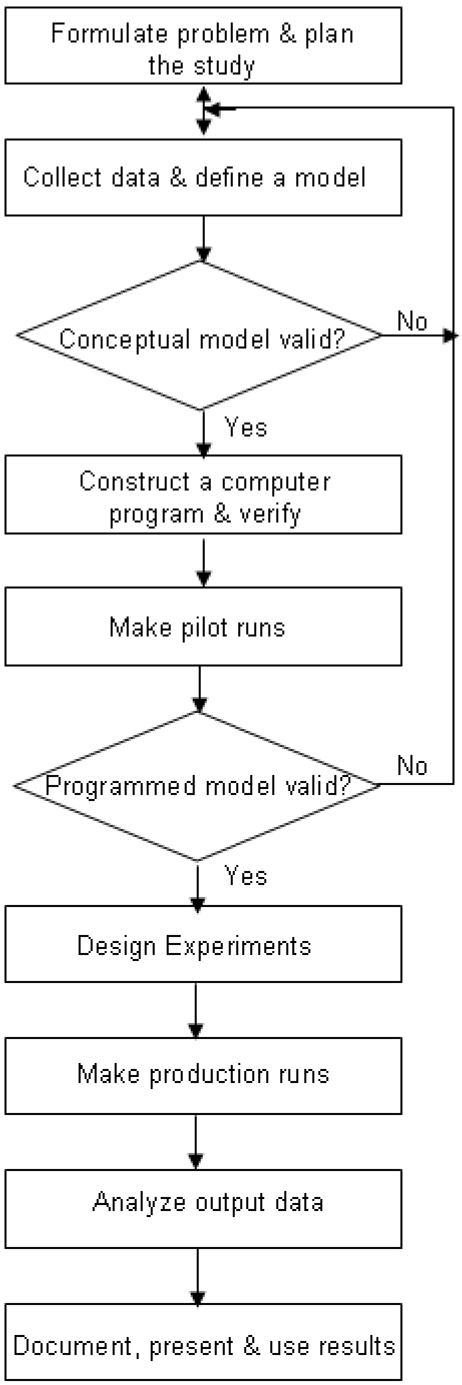

Figure 5 Steps in a Simulation Study

9. Conclusion

To again quote from Law and Kelton, Simulation Modeling and Analysis, "Steps in a Sound Simulation Study - …realize that model programming is just part of the overall effort to design or analyze a complex system by simulation. Attention must be paid to a variety of other concerns such as statistical analysis of simulation output data and project management. Note that a simulation study is not a simple sequential process." They suggest Figure 5 as typical of a simulation design effort. From experience the phrases, "variety of other concerns", "project management", and "not a sequential process" can certainly be emphasized.

Capturing and documenting the D-HACMD deployment planning process on this JT is my third effort using the SIMPROCESS modeling tool to simulate a real world system. As alluded to previously, it is always a challenge to interface the modeling design effort with the main thrust of the JT, in this case developing TTP to aid the warfighter with tangible products to make the deployment planning process most efficient.

The creation effort of an accurate process model and the increase in process knowledge of all concerned must be seen as beneficial and not just as a "side product." The pictorial view of the macro deployment planning process depicting the organizational inter-relationships is found nowhere else. The model is an excellent educational tool in presenting this important aspect. Having a person on the project that is solely looking at *detailed* process data capture is essential.

Because the D-HACMD deployment planning process has not yet been well codified or exercised frequently, data capture and model validation are both ongoing issues and will continue throughout the joint test. Since this IAD mission could occur anywhere in the homeland, the participants, environment and organizations involved may vary widely. We see these TTPs of necessity being dynamic and fluid, which reinforces the need for a process model, as a tool, to work through these variations.

10. Biography

Ron Cypert is currently employed by Scientific Research Corporation on his third OSD-sponsored Joint Test and Evaluation project. Since retiring from the Navy in 1999 he has also done Enterprise Architecture work for the Army's Space and Missile Defense Command Battle Lab, and the Defense Logistics Agency. He holds a Bachelor of Science degree in Industrial Engineering from the University of Oklahoma, and has done Masters course work in Modeling and Simulation at Old Dominion University.